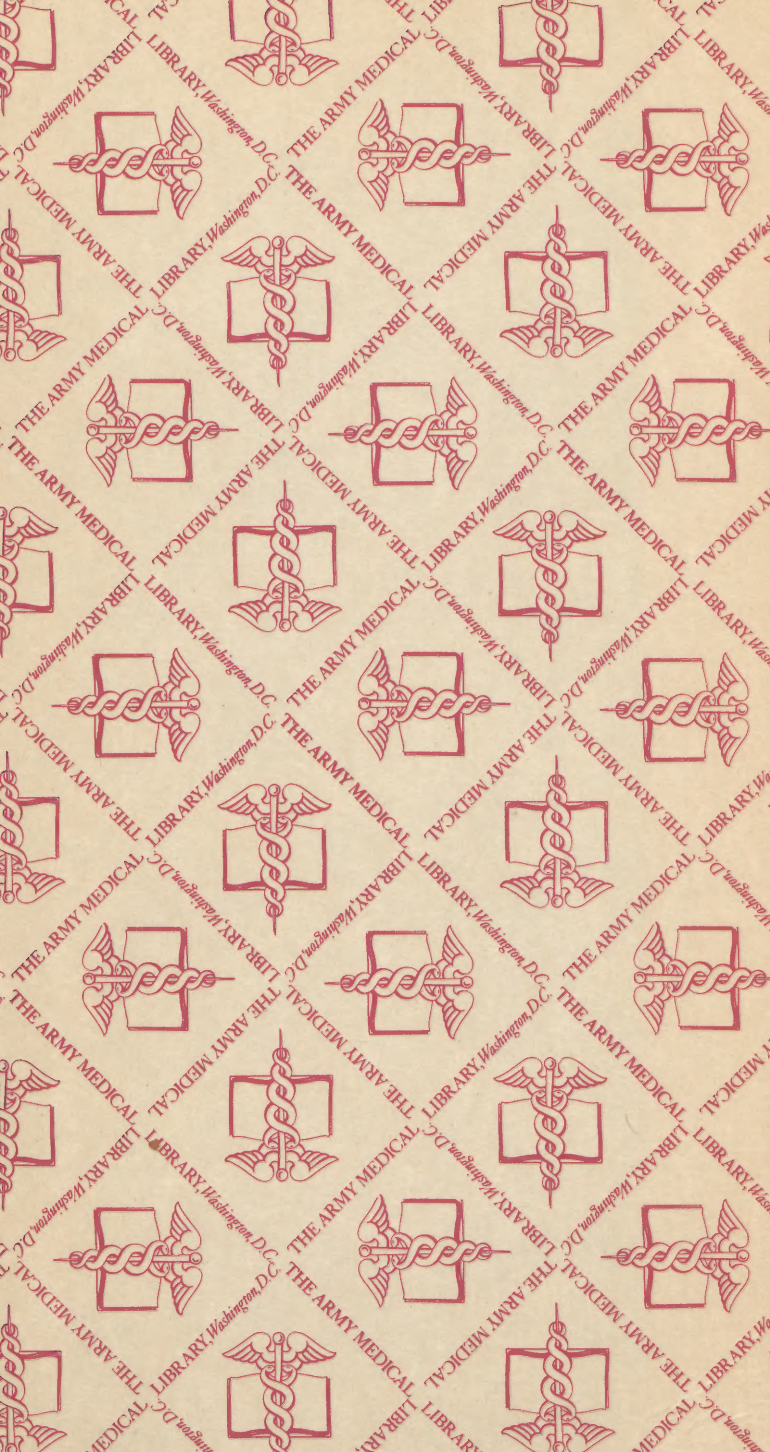
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OBSERVATIONS

ON

VENTILATION:

SHEWING THE

POSSIBILITY OF PRODUCING ATMOSPHERES

COOL AS WE PLEASE,

EVEN UNDER THE EQUATOR.

WITH

HINTS

AS TO THE PREVENTION OF THE

PLAGUE AND YELLOW FEVER.

BY

JOHN VALLANCE.

LONDON:

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PATERNOSTER ROW.

1821.

TO THE

RIGHT HONOURABLE

THE

EARL OF CHICHESTER,

As an evidence, that the interest he was pleased to express, and the efforts he was so good as to make on the subject, are gratefully remembered, the following Observations are respectfully dedicated.

PREFACE.

On placing myself at the bar of public opinion, it may be permitted me to desire that the feelings with which I appear there should be seen.

I approach that bar, under the influence of feelings, in some degree similar to those experienced by him of antiquity, who lived destitute of the power of speech, till the emotions excited on beholding the sword descending on his revered parent, overcame the impediment nature had interposed. Since, as with him, articulation was not, until an overpowering sentiment possessed him of it, so had it never been in me to have attempted the press, if the failure of every other method, by which, what appears to me an important subject could be rendered public, had not driven me to it. As therefore, it could not have been expected of one who had but just received

the power of speech, that his pronunciation should be correct, neither can it be matter of surprise that the diction of one who has before never used the pen but for epistolary purposes, should be defective: and also, as the errors and inelegancies into which *he* should fall, would be passed over as resulting from what had been his situation; so I trust, will those into which I have fallen, be regarded as more my misfortune, than my fault. Since, as doubting my capability, I have not ventured on the press, until *every* other method of making what I have to submit, public, had been unavailingly tried, and as the certainty of the principles on which it is founded, leaves no alternative as to whether or not the press should be ventured on; point blank as I stand exposed to the fire, even of the lightest critical artillery, yet can I not but hope, that as I did not, without first trying all possible means to avoid it, place myself there, it will be levelled at me more in mercy than in judgment.

And to render forbearance to the extent which will in this particular be necessary,

as little irksome as possible, it has been my object to say no more, than the view which I conceive it essential to give of the subject, rendered indispensable.

I have therefore entered no further, either on the manufacturing and mechanical practicability, or the general ways and means of what I propose, than the professing myself capable of surmounting the mere difficulties of *operation*, absolutely required; though I am ready to enter on the minutia of the manufacturing and mechanical difficulties of the case, and to prove them perfectly superable, whenever it may be necessary.

OBSERVATIONS,

&c.

"Impossible" may not unaptly be termed, the nightmare of speculative philosophy; and "impossibilities," the changeful drapery in which the incubus is shrouded. Thus, the circumnavigation of the globe—the knowledge we have attained, as to the laws of planetary motion—our ability of rendering the dread bolt of heaven innocuous—and indeed, the whole of the modern attainments of science, were once "impossible:" and the being, who, in those times had predicted the triumphs, which man, by his mere native powers should obtain over the elements, had been deemed, worthy only of that fate, which the fable represents the travelled horse to have received, for stating, that he had seen the torrent arrested in its course, and changed into a substance, immoveable as the rock of the desert.

It is well known, that meetings of a public nature, whether for pleasure, business, or devotion, are subject to inconveniences, arising from the atmosphere of the building in which they are held, becoming affected by the respiration of the people assembled; and that the consequences of its becoming so affected, are always oppres-

sive and unpleasant, sometimes serious, and occasionally fatal. It is also known, that ventilation, though it lessens these evils, does not prevent them; for the reasons, that when the weather is hot, the provisions for it are insufficient to the carrying off the respired, and introducing fresh air, in sufficient quantity; and that when it is cold, the admission of fresh air, in sufficient quantity to prevent any accumulation of the respired and heated air, cannot be permitted, owing to its giving those with whom it comes in contact, colds, &c.

It is well known, that these are the causes which bring on the distressing heats, and unhealthy atmospheres, to which public places are subject: and as the intensity of these inflictions varies with the weather, and is more or less distressing, as it is hotter or colder; and as the weather is what man cannot control—it is for these reasons universally supposed, that the evils we thus suffer under are inseparable from our state, and what we cannot set ourselves above, and be free from.

But universal as this supposition is, it is

erroneous; there being well-known principles, by which, it is equally possible to, at all times, produce and maintain the temperature of the temperate zones, even under the equator, as it is to produce that temperature in the frigid zones by means of fire.

It is known, that on the vaporization of liquids, their capacities for caloric are much increased—that by removing the atmospheric pressure, their conversion to vapour is much facilitated—that on combining with this, Professor Leslie's method of condensing vapour and keeping up the effect of the vacuum by means of absorbents, evaporation may be caused to take place even from ice—and that in consequence, caloric may be abstracted to an extent, *many degrees lower* than that required for the congelation of mercury, or 39° below zero.

It is also known, that the capacities of gases for caloric are variable—that these capacities may be decreased, or increased, by the addition, or removal of pressure—that, if subjected to condensation, a portion of

their latent caloric, passes from its state of latency, to that of free, sensible caloric*—and, that on being released from this condensation to the state they were before in, they will absorb, and render latent, a quantity of caloric, equal to that which the condensation had, as it were, expressed from them. Now, by availing ourselves of and combining these principles, climate may be so effectually counteracted, as for it to be as much mere matter of volition, whether the temperatures of the temperate zones, shall be produced under the line, as the possession of fuel, &c. would render it dependent on the will, whether those temperatures,

* "The gaseous substances are so loosely constituted, that a difference in their composition, is sufficient, to alter materially, their intimate properties. Thus, common air, on being condensed thirty times, has its capacity for heat, reduced to one half; and, if *suddenly* compressed, to twenty times its ordinary density, it will disengage so much heat, as to shew an elevation of temperature, equal to 900° by Fahrenheit's scale, and sufficient for the inflammation of most bodies. On this property, is founded a pretty contrivance, lately made in France, for procuring a light—the stroke of a small condensing syringe being employed, to set on fire a bit of tinder."—Leslie, on the Relations of Air, to Heat, and Moisture.

should be produced within the frigid zones. Since, if air be condensed sufficiently to change a portion of its latent caloric, from the state of latency, to that of free, sensible caloric—if, in this condensed state, it be reduced in temperature, as the availing ourselves of Leslie's method of producing artificial cold will enable our doing—and then suffered to mingle itself with a quantity of uncondensed air, which is being injected into any building, caloric would be absorbed, and rendered latent by it, and the temperature of the uncondensed portion consequently lowered, according to the relative states and quantities of the two portions.

All therefore, that it is necessary to do, to produce whatever temperature might be desired, whether in the temperate or torrid zones, is to operate in this manner to a sufficient extent, and any building it might be wished to ventilate, could be supplied with an atmosphere, cooled to whatever degree habit, or climate, might render desirable, be the weather hot as it may: and, as the scale, on which Leslie's method of producing artificial cold may be acted upon, is, notwithstanding the opinion which prevails to the

contrary, co-extensive with our manufacturing capabilities, and as these are vastly more than sufficient for any purposes connected with the subject before us, and also, as I shall be able to prove the mechanical difficulties of the case much more easily superable than may at first be supposed, the means of supplying public assemblages, wherever situated, with atmospheres of whatever temperature might be desired, are indubitably in our hands, provided we choose but to make use of them. Since, as power and pneumatic apparatus give these means, and as our manufacturing and mechanical capabilities, possess us of both, to extents almost infinitely beyond what would be required, the question becomes one of expediency merely, and the only decision necessary, whether we will, or will not, be at the *expense* of so counteracting the excessive heat, which is, within the tropics constantly, and without them occasionally experienced, as to produce in public buildings, whatever temperature habit and situation may render agreeable. This is the only question; and though nothing but the actual application of the principle on a practical scale, will enable this

question's being *correctly* replied to; yet, as there are well-known circumstances, which put it in our power to obtain a sufficiently close approximation to the means required to produce these temperatures, to shew it in every way practicable, the subject may be entered upon free from any other uncertainty, than that the amount of the means necessary to produce effects we might desire, may be underrated.

The circumstances to which I allude, as putting it in our power to obtain this approximation, are, collectively, the whole of the occurrences, by which the theory of the capacities of gases for caloric, is confirmed; but more particularly, that experiment of Darwin's,* by which he found that air, on liberation from a condensation of about an atmosphere, to the common atmospheric pressure, absorbed caloric to an extent which reduced the thermometer 4^0—and the phenomena, attending the emission of condensed air, from the fountain of Hiero, in the mines of Chemnitz—which are, that on the liberation of air from a condensation

* Philosophical Transactions, vol. 78.

of barely eight atmospheres, caloric is rendered latent to an extent, sufficient for the instantaneous production of both snow and ice.*

From these circumstances it is seen, that on the liberation of air (after the caloric which the condensation had rendered free, had been carried off, and the condensed air reduced to the temperature of the atmosphere) from a state of condensation to the atmospheric pressure, caloric is absorbed and rendered latent, to, in the one case a very sensible, and in the other, to a very considerable degree.

By, therefore, operating in this manner—condensing air, to the extent, we will say, of *ten* atmospheres—enclosing the vessel (a cylinder, placed vertically) it is re-

*"The striking phenomena observed in the fountain of Hiero, constructed at the mines of Chemnitz, in Hungary, afford the best example, of the production of cold, by rarefaction. In this engine, the air in a large vessel, is compressed by a column of water, 260 feet in height: on opening a stop-cock, it rushes out with great violence, and in expanding, the watery vapour which existed in it, is not only deposited, but is congealed, falling like snow, or adhering in icicles, to the aperture of the stop-cock. (Philosophical Transactions.")—Murray's Chemistry.

ceived in, in another—percolating water, which has (as may by Leslie's method easily be done) previously being cooled to 32°, upon this receiving cylinder, so as for it to be constantly wet on the whole of its outer surface, and consequently, under similar circumstances with thermometer bulbs, when mercury is frozen in them by evaporation on the Professor's principle—causing this water to carry off the liberated caloric of the condensed air, by producing a vacuum in the outer cylinder, and in consequence, permiting the water to pass into vapour even after it becomes frozen, and has coated the enclosed cylinder with ice—and then, preventing any diminution of the effect of the vacuum, by condensing the vapour by sulphuric acid—as, by operating in a way, which, though somewhat different from this in method, is similar in effect, mercury may be easily frozen, there can I think be no doubt, but that by doing thus, the condensed air might be cooled to at least zero ;* and from the instances I have

* "But after the water has all become solid ice, the circle of evaporation, and subsequent absorption, is still main-

referred to it is equally evident, that on liberation from this condensation, the capacity of the so-treated air, would be increased to an extent which would reduce its temperature much lower. How much, cannot be said, though (inferring from those instances) it would doubtless be *many degrees* lower.

If, therefore, when the atmospheric temperature was 85°, air were treated thus to an extent which would render it 27° below zero on liberation from the condensation, and then admitted to mingle itself with uncondensed air in the proportion of a fourth, it would absorb, and render latent caloric, sufficient to reduce the temperature of the mixed portion to 57°, below which, it would not perhaps be desirable to have any building when the external atmosphere was 85°.

I am aware it will be urged, that against

tained. A minute film of ice, abstracting from the internal mass, a *redoubled* share of heat, passes, by invisible transitions, successively into the state of water, and of steam, which, dissolving in the thin, ambient air, is conveyed to the acid, where it again assumes the liquid form."—*Leslie—Relations*, &c.

the method of procedure which I have referred to, there is a fatal objection, owing to the limit, as to magnitude of application which Mr. Leslie has found to take place, whenever any portion of water was situated at more than a few inches' distance from the acid ;* a circumstance, which, were the operation attempted on the scale that would be necessary, to produce any effective result as to ventilation, could not, it will be said, be avoided. But the difficulty as to largely acting on the Professor's principle, which this at first appears to interpose, may, by a variation of process, be both so obviated, as to admit of operating on whatever scale, our manufacturing

* "But though the freezing of water is always performed to the best advantage in a large apparatus, a limit will soon occur to the scale of magnitude. Since, as the efficacy of the process, depends on the quick circulation, maintained between the opposite exhaling, and absorbing surfaces, and consequently, on their close proximity, the very extent of those surfaces, must have a tendency, to retard, and enfeeble their operation. Accordingly, when the earthen pan is unusually wide, the central portion of its water, being most distant from the acid, seldom becomes firmly congealed." —*Leslie—Relations*, &c.

capabilities will enable our constructing apparatus, and so as to produce a greatly increased energy of action: since, if, instead of following the usual course, of placing the absorbent acid *under*, and consequently (even when refrigeration on the smallest scale is effected by this process) at some little distance from the central portion of the water, I follow the principle on which the outside of the inner cylinder (or receiver) is moistened, i. e. put around it (vertically) a cylinder, or rather cage, composed of strips of lead, an inch wide by an eighth thick, placed edgeways towards the receiver, and each half an inch apart—which cage is so much larger than the receiver, as for there to be a space of an inch, or more or less, as experience may shew best, between them—and then so arrange, as that the whole surface of the strips composing this cage, are, by a peculiar method of affusing it on the tops of them, constantly covered with a thin surface of sulphuric acid; if the process is thus (as may easily be done) arranged, not only will the preventative as to magnitude

of operation to which I have referred, be obviated, but also will a far more intense action take place, owing, both to the evaporating, and absorbing surfaces, being thus brought into more direct communication, than it is any how else possible to bring them; and also, to the great increase of absorbent surface (as many times that of the water, as we please) that may thus be exposed: which intensity of action may be increased, until the two surfaces are brought so near together, as for the radiation of caloric from the outer, to be equal to the effect of evaporation from the inner surface. This, therefore, is the course I propose following; and as there is no difficulty, as to manufacturing condensing, and exhausting apparatus, on whatever scale of magnitude may be required, there are certainly no *physical* impossibilities, to the adoption of the plan.

Now, assuming that a condensation of ten atmospheres, will be sufficient to reduce the temperature of the air to 27° below zero on its emission from the condenser, it is easy to tell what would be the power required, to produce and maintain in any building, an

atmosphere tem. 57°, when the external air was 85°; since, as a steam engine of the power of one horse, can (calculating on the established relations between animate and inanimate power) be proved capable of condensing to a degree equal to ten atmospheres, 25 gallons of air per minute, whatever quantity of condensed air might be required, divided by 25, gives the power necessary to condense it. On the supposition, therefore, that it were the question, "What power would be required to supply the two Houses of Parliament, or either Drury Lane or Covent Garden theatres—the former with each 500, and the latter with each 5000 gallons of air per minute, tem. 57°, when the atmosphere was 85°?" (1000 or 5000) ÷ 4 ÷ 25, shews, that in the one case a power equal to 10, and in the other to 50 horses, would be required; a mean, which, when reduced as the method of operation I have arranged admits, will become scarcely a question. As, therefore, it may be seen very evidently, and as I have it in my power to shew it very easily practicable, so to operate on air, as to supply any building, under any parallel of la-

titude, and at any time of the year, with an atmosphere of whatever temperature we please, I may proceed to state how it will be best to do it, and by what means the process may be so facilitated, as to produce the saving of power I have referred to.

As to the first consideration, "How it will be best to do it."

As mechanical power must be made use of, both for the purpose of condensation, and to produce the vacuum by means of which the condensed air is to be cooled; and as the additional power which would be required for that purpose is next to nothing,* it would (independent of the necessity there is for it) almost become matter of course, that the uncondensed air, instead of entering spontaneously, should be *injected* into the place to be ventilated. By

* The injecting (as would be required for ventilation—not under the resistance opposed in the air cylinders of blast furnaces) even 100,000 gallons of merely *fresh* air per minute, would not be a difficult operation; so that the power which would be required, for the quantities I have referred to, is not worthy notice.

means of blast cylinders (so arranged as to prevent the air having the least smell imparted to it, or being in any way deteriorated) this, therefore, would be done, and the air caused so to enter the place, as to be *imperceptibly*, and without either gusts or currents, distributed over the floor; whence it would gradually rise towards, and pass off by, the ventilator. Before, however, it entered the place, the condensed air would (from a kind of insulated chamber, in which it had previously expanded, so as for its moisture to have been congealed and precipitated) be emitted into, and caused to mingle with it; and its temperature consequently be lowered, according as the condensation and refrigeration of that air regulated; and as the method of condensation is also so arranged, as to prevent that air having any oleaginous, or other effluvium imparted to it, as is the case with air condensed in the common way, nothing objectional can arise on that particular. Such is the course taken with the uncondensed air—merely to inject it imperceptibly, and free from effluvia, into the place.

With the condensed air, I proceed as follows. Instead of condensing it as commonly done, by a mere equi-potent pressure, I take advantage of the inequality of the resistance it opposes to a piston, to bring gravitation and momentum into action, and produce a very great increase of effect thus—

If air were to be condensed in the large way (whether by horses, a steam engine, or any other means of mechanical power) according to any of the methods hitherto followed, effects, equal only to the power exerted would be brought about; that is, a condensation, proportioned only to the force with which the power pressed down the piston of the condensing cylinder, would be produced; and, supposing that the area of this cylinder were equal to ten inches, and that the piston were forced down by a power equal to 1500 lbs. a condensation of ten atmospheres would take place; and corresponding with this, would be the result of the application of any greater power; that is, the effect produced would be proportional to the power exerted, and no

more. But, if, instead of operating in this manner, I arrange the following method of operation; that is, instead of employing the power of the engine, to press *down* the piston of the condensing cylinder, I make it *raise it up;* and if (loading the piston rod at top with the 1500 lbs.) when the piston is at the top of the cylinder, the machinery by which it is raised lets it fall, as is done by the weight, driver, ram, or whatever it is called, employed for driving piles, it is evident, that the effect produced, would be greater than the power exerted, owing to the air beneath the piston admitting the weight to acquire very considerable momentum, before it became sufficiently condensed to oppose any effective resistance to it—that a condensation greater than ten atmospheres would be brought about, in consequence of this momentum—and that this increase of effect, would be proportioned to the height from which the weight falls, that is, to the length of the condensing cylinder. This, therefore, is the principle, of the course of operation I propose.

Having arranged a method of construc-

tion which admits it, I purpose having the condensing cylinders ten, twenty, thirty, or more feet long; and then, loading the pistons of these cylinders, with weights proportioned to the condensation required, and employing the machinery by which they are driven, to *raise them up* instead of *pressing them down*, to let them fall from the tops of the cylinders, when the momentum they would acquire in falling would so increase the effect produced, as to render it a (comparatively) very easy thing to condense air to whatever extent may be required. How easy may be inferred thus—A body, falling from the height of thirty feet, acquires I find, momentum to an extent, which will give it percussive effect, sufficient to cause it (though not to any height, yet very perceptibly—the eighth of an inch for instance) to raise sixty times its own weight. Now, owing to air possessing the property of favouring the method of condensation I point out, by opposing, at first, no resistance to the descent of the piston—a resistance of only one tenth the weight (when it is equal to ten atmospheres per inch) the piston is loaded with, when

that weight has fallen half the distance it has to fall—a resistance of barely one third that weight, when it has descended three fourths—a resistance but little more than three fourths, when the weight has descended seven eighths of its distance—and a resistance equal to the weight itself, not before it has descended the whole distance, through which the piston, were it forced down by machinery of any kind would have to descend; owing to this property's thus admitting momentum's being acquired, the method of condensation I point out, will produce effects greater than what would be produced by condensing in any other way, according to the degree in which the length of the condensing cylinder allows the weight to acquire momentum; and, though, owing to the difference between the momentum of a weight which has only to displace the air through which it falls, and that which is counteracted by the constantly increasing opposition of the air confined beneath the piston it forces down, this effect will not be increased in any sixtyfold degree, yet, as in consequence of my having so arranged the method of operation with

these pistons, as, while it does (as to any counteraction of effect) *entirely away with friction* between them and the cylinders, renders *totally impossible* the escape of any condensed air by them, the effect would doubtless be increased in a *manifold* degree, I consider, that in calculating on only a quadrupled increase of effect (that is, either the same condensation by one fourth the power, or four times the quantity by the same power) from this method of operation, I stop greatly short of the extent to which I might go. In saying, therefore, that instead of engines of 10 and 50 horses' power, being required to supply the Houses of Parliament with 1000, or either Drury Lane or Covent Garden theatres with 3000 gallons of air per minute, tem. 57^0, when the atmosphere was 85^0, it may be expected that engines of—in the one case only $2\frac{1}{2}$, and in the other only $12\frac{1}{2}$ horses' power (the vacuum for cooling the air, being so easily produced as not to be worth notice) would be required, I say, what may cause the practicability of the question in point of power, to be considered as sufficiently

evident, even supposing me to have greatly overrated the effect of the method of condensation I point out, and that the power required, should be twice or thrice as great as I have stated it.*

Having thus (which is all that I deem it necessary to do here) sufficiently illustrated the principle, to give a general idea of the course to be taken, and means required for the purpose, I may turn to the advantages that would be derived from it.

And taking them seriatim, that which I deem its greatest, so far as relates to convenience merely, is the effect it will have as to the comfort and health of the Bench and the Bar. By the other classes of society, heated and deteriorated atmospheres are only occasionally, and then but for short periods experienced. But by those who preside and conduct in the courts of judi-

* It may be as well to observe, that though, for convenience of illustration, I have referred to the *pistons* as what the weights would operate upon, yet that, in point of fact, the reverse is the case: the course of operation being to raise and let fall the *cylinders*, instead of the *pistons*—in two words, the charging syringe of the air-gun, on a large scale.

cature, the evil is experienced to a degree which only such as have undergone what a long trial, a crowded court, and hot weather inflict, can conceive.

Not that it is not bad enough, in either of the Houses of Parliament. But, as between the assemblages which convene in them, and the heterogeneous mass of a Court House, there is the great difference produced by clean linen, constant and copious personal ablution, and polished habits, the worst atmospheres experienced there, fall far short of those of the other.

And, indeed, there is but one thing that I can conceive as worse, than the heated, mephitic vapour, sometimes encountered on entering the criminal courts—particularly during any trial interesting to the lower classes; and that is, the atmosphere of the hold of a slave-ship. This, and this alone I can conceive, as worse than the surcharged, sickening atmosphere, of a crowded, criminal court. Now, from the whole of this, may both the Bench and Bar be relieved by the process I have described; and the

courts (both metropolitan and provincial) be kept so pleasantly and healthily ventilated, and (both in summer and winter—as will be exemplified in the course of the work) of so uniform and agreeable a temperature, as shall not only be of incalculable benefit, to the health of the dignified and learned characters, who preside, and lead in them, but also, shall materially conduce to the comfort of such of the magistracy and gentry of counties, as by either a sense of duty, or other circumstances, may be caused to attend them; and this independent of the relief which juries, attorneys, and the public, would experience.

This, I consider, as the principal benefit we may derive from what I propose.

That which ranks next, must, of course, be the advantage which would result to the members, both of the upper and lower Houses of Parliament, from their atmospheres being rendered constantly temperate and salubrious, as they may be, whether the debates are long or short, the Houses full or empty, or the sessions in January or July; and, had the Upper House,

been then provided with the arrangements I have been describing, it is sufficiently evident, that the whole, both of what the noble members, and those whose duty it was to attend them underwent, during the painful investigation of last summer, might have been prevented, and the building kept so uniformly temperate, as would have rendered the mere act of attending the inquiry, a very agreeable relief from the heat of the weather, instead of the parboiling it was.

Following (on account of the infrequency of their occurrence) this, are the Levees, and Drawing-rooms; both of which may be kept free, from what occasionally inflicts on the Majesty and Dignity, the Beauty and Delicacy of the nation, the whole of the preliminary symptoms of the Black-Hole sacrifice.

Succeeding these, are the theatres, Almack's, and other places of public amusement; the whole of which may be supplied with atmospheres, uniformly temperate and salubrious, and kept constantly of a pleasant temperature, whether they are crowded to excess, or empty.

After these come the residences of the

nobility, the leaders of the "haut ton," &c. the whole of the reception apartments of which, may be kept of whatever temperature they please at all times of the year, be their parties numerous as they may.

Next come confectioners' shops, hotels, taverns, &c. &c. which may all be accommodated with means of procuring atmospheres so cool and pleasant during hot weather, as shall cause them to be much resorted to as agreeable resting and refreshing places, and consequently occasion an increased sale of their productions. And indeed, I consider that this application of the principle will be somewhat important; as not only may shops, &c. be thus rendered, what during hot weather in town, will cause them to be much more frequented, but also may wines be iced, and creams, lemonades, &c. frozen in this manner, before the air that does it is allowed to enter the room, or shop, so as to render confectioners, hotels, taverns, &c. &c. independent of ice-houses for their supply of ice; and, unless I am mistaken, to be also decidedly cheaper, than their present method of congelation. This latter application of the

principle, will also be convenient to private life; as both may our wines, beverages, creams, &c. &c. be iced by it during summer, and our apartments cooled at the same time.

And lastly come, or rather will in time come, private houses; which, when experience shall have effected the improvements it brings about, will, I doubt not (by means of companies similar to the water companies), in many of the confined parts of London, be, during summer, so ventilated, as shall render apartments which are now hot as ovens, most gratefully cool and refreshing.

Such are the advantages we may derive from it as preventive of what we suffer from the heat of the weather and inefficient ventilation.

But these, are by no means the whole of the particulars in which I expect we may render the principle serviceable—as, unless I am altogether wrong, we may make use of it in a way, which, conducing to the preservation of luxuries of the table, and necessaries of life, will render it in some degree important as a national resource.

By the effect of the air emitted from the fountain of Hiero, it is seen that phenomena, similar to those of an arctic winter—that is, the instantaneous production of both snow and ice, may be produced by condensation alone—and it is of course, that if this were to be furthered by the air in its condensed state, being reduced in temperature, as availing ourselves of Leslie's method of producing artificial cold will enable our doing, air much below the freezing point, may be emitted into any place; and consequently, that we have the power of freezing whatever we choose to expose to the action of the so-emitted air.

Now, by the way in which provisions are occasionally kept in countries approximating the polar circle (and indeed, in some considerably remote from it), we learn, that if substances of an animal nature be reduced to below the freezing point, putrefaction is so much retarded, as for descriptions of food which, at other times of the year would not keep six days untainted, to be perfectly sweet at the end of as many months: and, indeed, inferring from the length of time bodies are said to keep free

from putrefaction at Spitzbergen, and from the state of the supposed antidiluvian remains found in Northern Asia, it might be said, that by a reduction of temperature to below 32^0, putrefaction, is not simply for a period, but for ever prevented.*

Now, as this is a temperature, which the method I have been pointing out, will enable our at all times, both producing and maintaining, those of the higher classes whose wealth renders it only necessary for them to *will*, that this, or the other gratification, shall be administered to their pleasures, may, in addition to having an *invariable* temperature maintained in their residences, be also enabled to have the productions and delicacies of peculiar seasons, all the year round. As, by having arrangements (a vault, or underground conservatory, somewhat similar to an ice-house for instance, so constructed, as to prevent any such admission of heat, as should coun-

* "At Spitzburg, the extreme cold will suffer nothing to putrefy and corrupt; insomuch, that buried bodies are preserved entire for thirty years, and inviolated by any rottenness. Bartholinus, de Usu Nivis, cap. 12."—Parke's Chemical Essays.

teract the effect) for the purpose of freezing, and keeping them frozen, those luxuries of the table, venison, game, salmon, oysters, and various other sorts of animal food, which are now to be had only at peculiar seasons, may be so preserved, as to be served up all the year round; it being only necessary to immerse whatever is thus kept, in cold spring water some hours before it is dressed, that it may be gently (though it must be thoroughly) thawed, and it may be brought to table unaltered in point of flavour.*

And, on the supposition, that the engine and apparatus, employed to keep any public place of a constantly pleasant temperature, were, when not wanted for that purpose, to be made use of—in freezing the

* "The Hon. Mr. Boyle relates, that the physician to the Emperor of Russia, assured him, that he had had the venison of elks sent him unsalted, and yet untainted, out of Siberia, which is some hundreds of leagues distant from Moscow; and that beef, and other flesh, *well* frozen, would keep for a very long time uninjured; and that it will have lost none of its natural flavour, provided it be very gradually and *thoroughly* thawed, before it be dressed for the table. Experiments on Cold, Quarto, London. 1683. p. 85."—Parke's Chemical Essays.

descriptions of food I have been pointing out—in icing creams—producing (which could most rapidly and cheaply be done) common ice for sale, &c. I doubt not, but that some of those purveyors of luxuries of the table, with which large places abound, would be willing to give so much for the frigorific use of it, as would repay all expenses of erection, if not render it a source of profit.

So far, as to rendering the principle available to the preservation and production of luxuries of the table. As to producing similar effects with reference to the necessaries of life, it is to be observed, that the superiority as to flavour and tenderness, which butchers' meat, that has been killed ten days or a fortnight, possesses over that which is eaten a day or two after killing, is so well known, that if it could be done, it would be always kept this time, or longer, before it is eaten.

During the greater part of the year, however, the state of the weather prevents this being done, owing to putrefaction commencing within that period. But by all places in which the method of ventilating

that I have been describing is applied to the courts of justice, the benefit of having butchers' meat kept as long as is desirable, before it is eaten, may be possessed; as, by emitting the air which has been employed to keep the more costly descriptions of animal food from putrefaction, to ice creams, &c. or to make ice, from the vault in which these effects would be produced, into a building which should serve as a public shambles, it would be kept so cold, as would both preserve meat much longer than it is now kept, and prevent its ever being fly-blown,* &c.

But it is not with reference to the species of food which falls under the description of butchers' meat, that I primarily referred, when speaking of the "necessaries" of life;

* In places where, as in Leadenhall, and the other flesh-markets of London, there are constantly immense quantities of animal food exposed to the putrefactive influence of summer weather, advantageous application of the principle might doubtless be made. As, owing to the possibility of keeping the whole of the meat there exposed, in an atmosphere of whatever temperature might be found best, its flavour would be so much improved, and putrefaction so set at defiance, as would, I expect, in the long run, amply repay the expense.

as, by applying the principle to the preservation of another species of animal sustenance, benefits, decidedly national, may I expect be derived.

If the observation, that "he who makes two blades of grass grow in the room of one, does most for his country," indicated the insight into the principles of public prosperity, it has been held to do, it follows, that the effecting any thing tantamount to this, whether with reference to vegetable or animal food, is doing a public service: and it will not I apprehend, need proving, that had individual perception and exertions, instead of the observation and ingenuity of generations, possessed mankind of the methods, by which the vast quantities of animal food annually drawn from the ocean are obtained, he would have been held up, as one of the greatest benefactors of the human race. Since, as there is no way, in which the same quantity of sustenance, can, in so short a time, and at so little expense be procured, as by the herring, pilchard, cod, mackerel, &c. fisheries; and as there is no species of food which can be sold so cheap

as those fish, during the season for them, it follows, that the ability of taking them to the extent which annually recurs, is equivalent to the power of raising two blades for one, over a very considerable surface of cultivation.

Now, though (as an insular people) we possess this power in a degree, superior to that of any of our neighbours, it is well known that we exercise it to a less extent; and much has been said to rouse us to a sense of our true interests on the subject, and to urge us to exertions similar to those of the French and Dutch. But, in treating on the subject, the advocates for increased exertions, and a more national interest as to our fisheries, have overlooked a circumstance, which (so far as relates to home consumption) most materially contributes to the indifference we manifest, towards what, as a maritime people, we ought principally to foster and encourage; that is, they have not taken into consideration the effect, that results from the state, in which the food so obtained, must be eaten. Had we been possessed of means of keeping fish,

other than by salting, or drying them, I doubt not, but that our fisheries would have had very much more attention, than they have yet received. But, with no other means of keeping what are not wanted for present use, than by preservation in salt, and drying—under the loss of original flavour which these methods occasion—with the superinduction of one less palatable—the thirst consequent on eating food highly salted—and the facility, with which even the lowest among us procure fresh beef, mutton, &c.—with these circumstances taken into the consideration, our indifference to the additional food we might derive from the vast pasture-grounds of the deep, is accounted for.

Were our lower classes like those of some other countries, so restricted to vegetable diet, as for fish to be an invigorating as well as palatable change, then would they, in whatever way cured, be relished by them. But, accustomed as they are to animal food, both (excepting when fish are fresh) more agreeable to the palate, and at all times more strengthening to the frame, there will

never (on the equality between our means of production and our population which at present exists) arise any greatly increased demand for the food we procure from the ocean, unless we can contrive so to keep it, as both preserving its original flavour, and doing away with the thirst and vulgar infirmity (vide Sir Toby Belch—Twelfth Night, act 1, scene 8,) it occasions, shall increase its consumption in the higher and middling classes of society, when the lower classes, would doubtless follow the "fashion" to a degree, which might, perhaps, give rise to that cultivation of our watery patrimony, which has been so long, and so justly, advocated.

Now, though I cannot take on me to say that it is *certainly* in my power to point out a method of so keeping fish, as shall combine these desiderata, of preserving their original flavour, and preventing all liability to thirst, or vulgar infirmity, from eating them, yet do I conceive myself abundantly authorized to state, that *I think* it is in my power to do this. As, if a temperature of about 32° will perma-

nently prevent putrefaction, and if it is in our power to produce and maintain that temperature (one of which is well known,* and the other I trust, abundantly shewn to be the case), it would follow, that produce, and keep constantly up this temperature, and you bring about these effects to whatever extent you please. Shew, therefore, the advantage that might be derived from thus doing, to be so much greater than the expense of it as would leave a handsome profit, and it becomes matter of course, that the preserving *fish* in this way would be undertaken, and that some of the advantages, which the advocates for an increased attention to our fisheries point out, would be derived from it.

As, however, to *demonstrate* this incontrovertibly, would require an extent and accuracy of data I do not yet possess, I must content myself with merely shewing it, certainly possible, and probably advantageously practicable.

* Particularly by the denizens of Billingsgate: since, while the ice, in which the salmon they receive from the north are packed, remains undissolved, the fish keep sweet, and good; but, as soon as it is all thawed, putrefaction begins.

The doing this divides itself into two considerations—how can the fish be kept, and how could they be advantageously disposed of?

To the first of these is to be replied—If, into an underground conservatory (vault, that is, well insulated, &c. so as to prevent the admission of heat) of such dimensions (100 feet long, 30 wide, and 15 deep) as would give a capacity of 45,000 cubic feet, air were injected at the rate of 500 gallons per minute, the whole atmosphere of the place would be renewed every nine hours, or say (a day's work being only ten hours) once a day; and to inject this quantity, reduced to the temperature of, say zero, would require an engine of five, though, to be on the safe side, we'll say ten horses' power. Now, an engine of that power, with the apparatus necessary for operating on the air, I am perfectly satisfied would not cost so much as 5000*l*. As, however, there is, with reference to the apparatus uncertainty, to be on the right side in this particular also, I will suppose engine, and apparatus, as costing 10,000*l*.; and as the fuel (a bushel of coals being capable of

producing an effect, equal to the labour of ten horses for an hour) and attendance the engine and apparatus would require (supposing the engine to be working ten hours a day, for six days of the week), would come to (fuel, 4*l.* 10*s.*; the engineer's and his labourer's wages, 3*l.* 0*s.*—7*l.* 10*s.*; though, to be still on the safe side, I'll say) 10*l.* per week, here is capital embarked, and expense incurred, to an amount of 1020*l.* a year, exclusive of the rent of, or per centage on, the cost of the vault, which I will consider as 80*l.* per annum more, making an aggregate of 1100*l.* annual expenditure; which aggregate, I will again increase by 400*l.* on account of the labour of hanging the fish up, clerk's salary, &c. We thus incur an expenditure of 1500*l.* per annum, to effect the purpose of injecting per diem, 300,000 gallons of air at the temperature of 0°, into a place, in which it is intended that fish shall be suspended, for the purpose of being, if not frozen, yet reduced to a temperature so near the freezing point, as, preventing putrefaction, would keep them as long as we pleased.

The next question is, On how many fish will the capacity of the place thus treated, enable our producing this effect?

Prior, however, to replying to this, it must be observed, that as I consider mackerel and herrings (and in some places salmon, oysters, and scollops) the only fish, with reference to which it would be greatly advantageous to make these arrangements, I shall confine my observations to them.

And of the first—mackerel, as it would be possible to suspend ten of them in a cubic foot, 450,000 is the number on which this preservative effect might be produced. Having thus the amount of effect produced, the consideration next becomes, What would these fish cost, and what could they be sold for?

An offer of threepence each, or thirty-three shillings per hundred (fisherman's tale) for mackerel, is I believe, a price for which, whatever number was wished for, could be got gutted, cleaned, and ready for suspension.

And at this price, 450,000 would come to *5625l.*

Now, if I bear at all correctly in mind the selling price of mackerel in London, sixpence apiece, is what might certainly be got for them there, if sent to market at such a period after the mackerel season had ceased, as would admit of the public palate's recovering from the satiety, which the abundance of a plentiful season, may be supposed to create.

If, therefore, they were kept till then, and then sold at that price, 4125*l.* is the amount of profit that would be made by them, supposing them to be sold no where but in London, and at only sixpence each; to neither of which, do I expect, the course of sale would be restricted. Since, as (there being in mackerel, on an average, a pound and a half of good, firm food) they would at this price, be decidedly cheaper than butcher's meat, and also, as the great quantity of ice, the apparatus would (without any increase of expense*) produce, would

* Among the particulars Mr. Fisher details, relative to the Polar Expedition, he states, that on the 15th of February, 1820, when the thermometer stood at 50 below zero, water, dropped from the main-top, (a distance of 40 feet 8

enable our doing by them, as is done by salmon—*i. e.* packing them up in ice, so as for them to be sent inland, to places where they are now never tasted, I see no reason to suppose, but that the demand for them, would be increased to an extent, which would cause them to fetch *more* than sixpence each.

But this is not the whole of the advantage that might be derived. In the estimate of

inches,) was frozen into spheroidal pieces of ice, before it reached the roofing of the deck. Now, as the rate at which water gains, or loses heat, is proportioned to the *surface* it exposes, to the communicating, or abstracting medium, and as there is no way of causing it to expose so much surface, as by following the principle on which icicles are formed, *i. e.* percolating it upon a vertical solid, so as for it to be circumfused as thinly around that solid, as its gravitating principle will admit—as there is no way of abstracting caloric from, and consequently freezing water, equal to this, by treating it thus, in the pipe, or aperture, by which the freezing air passed off from the vault, ice might, unless I am *altogether mistaken,* be produced in *greater* quantity, than we could ever have occasion for it; and at an expense, less than that of procuring it, as got for ice-houses, in the proportion of the difference, between suffering the waste water of the engine to *run* to be frozen, and the labour attending the transporting natural ice, from where it is procured, to where it is kept; and this, independent of the expense of packing it, and then getting it up again for use.

expense, it will be seen that I have included the disbursements of the whole year. But instead of the probabilities being, that the fish thus preserved, would require the whole year to be disposed of, they are so much the other way, as that it is to be expected, the fish would be all sold before the herring season came in; and if so, there might be a second per centage made upon the capital embarked.

Since as, on the supposition that the place was cleared of mackerel, by the time the herring season came in, herrings could be kept in the same way—as the number that could thus be kept (allowing thirty to a cubic foot) would be 1,350,000—as they could be got at the rate of a farthing each, or two shillings and ninepence per hundred (taker's tale)—and as they could doubtless be sold again at three farthings each, or eight shillings and threepence per hundred (which would render them only about half the price of butcher's meat), 2812*l.* is what would be made by the transaction; which, added to what was before gained, gives a profit (calling the capital embarked 20,000*l.*) of above 34 per cent. a re-

turn, which would be ample inducement to capitalists, so to embark in it, as would at once render the thus preserving piscatory food a national object, provided the data on which I have calculated are correct, and that the flavour of the fish should be uninjured, by thus keeping them.*

It will be observed, that I have gone only roundly into the subject, and that minor considerations, such as the expense of transporting the fish from where they would be taken to Town, the exact amount of capital required, &c. &c. are not touched on. The reason of this, will at once be seen to arise, from its being unnecessary to dwell on minutia of this nature, provided a *generally* correct result is given; and that what is

* And that nothing of this kind would take place, may at once be seen, by all who partake of salmon in London.

Since, as those fish have all been kept from putrefaction, during their transportation, from those parts of Scotland, and the north of England, where they are taken, to Town, by being sent, packed up in pounded ice, and consequently kept at a temperature of about 32°; and as they keep sweet, a longer or shorter period (a fortnight—three weeks —or month) according as the quantity of ice put around them, remaining undissolved, prevents their becoming of a higher temperature, here is proof, that no deterioration in point of flavour, would arise from what I propose.

passed over on the debit, is, (as is now the case,) decidedly less, than what is omitted on the credit account; particularly, when the other uses and advantages, which it is evident, might be made of apparatus capable of producing ices, &c. are considered.

The circumstance, of course, applies to salmon, oysters, scollops, and, indeed, to all fish that are taken at particular seasons only; profits on which might be made, as circumstances rendered them more or less, articles of luxury.

These are the advantages, I expect we may derive from it, as applicable to public convenience and benefit. But these, though considerable, are by no means the whole of the particulars in which we may render the principle available to our service; as by a somewhat more operose method of procedure, it may, I think, be made to produce effects, important perhaps to scientific research.

The difference between our capabilities as to the production of temperatures above, and below the zero of Fahrenheit, and that our range on the ascending, is many thou-

sand times greater than that on the descending scale, is well known.

Now, by operating with a succession of apparatus, and increasing effect by a combination of influences, our range on the descending scale, may, I expect, be increased to an extent, which, if it will not actually decide whether the zero of calculation, is that of fact, will, at least, enable our producing temperatures very much below any that have yet been obtained, and approximate us, perhaps, as closely to the real zero, as it will ever be possible to attain. Since, if the condensation of the air operated upon, were to be increased as we have it in our power to increase it—if, when thus condensed, the vessel in which it was, were surrounded with one of the most intense of the freezing mixtures—and if the air, when thus cooled, were to be emitted upon, and around, another condenser, in which other air was compressed to the same degree—by carrying this method of operation home, the air emitted from the last condenser of the series, would, I expect, be as near the real zero as we shall ever be able to attain;

and perhaps, both enable our reducing those of the gases, which have yet been obtained only in the gaseous, to the fluid, or concrete state, and (it may be) open a new door, of chemical investigation.

But neither is this the last of the particulars, in which I expect we may render the principle serviceable at home; there being yet to be noticed, one, which, though not so widely beneficial as these may be, is perhaps, more vitally important.

We all know, that our national complaint consumption, intermits with the weather, and that the unfortunate subjects of it suffer more or less, and are carried off, more or less rapidly, as that is mild or severe. Now, if a chemical change does not take place as to the constitution of the atmosphere, in winter and in summer—and that there does, no one has yet, I believe, found reason to suppose; and if all the difference between the summer and winter states of it, is that produced by its being of a lower temperature, and more charged with vapour in one than in the other—and that this is the only difference, would (independent of chemical

analyses) appear from the relief experienced by asthmatic, and consumptive subjects, on entering a warm, dry room, after being exposed to a cold, damp air—if this is all the difference there is, between the summer and winter states of the atmosphere, it is most certainly in our power, very much to relieve, and, I would hope, considerably to prolong the lives, of all who suffer under asthmas and consumptions among us: since, all that under this supposition, it would be necessary to do, is to supply some building,* in which those, who suffer under these afflictions, should, during winter reside, with an atmosphere constantly, (both night and day,) mild and dry—that is, of whatever temperature might be desired, and freed (artificially) from the damp vapours, with which it is, during winter, so frequently charged; and as, from the latter's being equally practicable as the former, this is what may be

* A kind of immense hotel, for instance, with a public room, of such length and width, as would be sufficient for ample exercise; and in which, though all who were in it would partake of the benefit it was built to afford, yet might any one, have single, or suites of apartments, to themselves.

done; it may be presumed, that many of those, whose only relief at present, is flight from our winter, to those of the south of France or Italy, may be benefitted to an extent, which only themselves can justly appreciate.

That in saying this, I shall be charged with the common fault of speculatists, carrying theory farther than practice can follow, I am well aware. But, if I see the case aright, this is a charge, which I shall be able to refute. Since, as it has only two features, those of attainment in point of practicability, and of expense; and as, unless I deceive myself, the peculiar circumstances of the affliction, render the latter, not more difficult than I trust to be able to shew the former, theory, will not in this instance go farther than practice, strange as it may appear, to talk of rendering the air as dry in the dampest and rawest days of winter, as it is in the driest and finest of summer.

Since, as by the effect of the emission of air, from the air-vessel of the fountain of Hiero, we learn, that if it be reduced to a certain temperature, under a certain de-

gree of compression, and then allowed to expand to the atmospheric pressure, the aqueous vapour it holds in solution, is instantaneously congealed, and precipitated, all that we should have to do to render air dry as we please, would be, first, to condense and cool it to below 32, that on liberation from the condensation, the vapour it held, might be frozen, and consequently precipitated, and separated from it, and then, to raise its temperature to whatever should be pleasant, and inject it into the place in which those, whom it is intended to relieve, were; when, owing to the dry state, to which the joint effects of the precipitation of its vapour, and the subsequent heating would bring it, it would enter the place, drier perhaps, than the air of any of the finest days of summer.

Having thus illustrated the attainment of what I propose, so far as practicability is concerned, I turn to the other feature of the consideration—its attainment in point of expense; and on this it is to be remarked, that though it would undoubtedly be considerable, yet, as the benefit would

also be great, and as by operating on the principles of pneumatic medicine, and availing ourselves of the (in this particular) softening effects of carbonic acid gas, we may *possibly* produce factitious atmospheres, soft as those of the mildest climates: in consequence of these capabilities, and of the wealth of many of those, who would be desirous of the relief I point out, I look upon what I suggest, though not as a thing of very easy attainment, yet as what is by no means impracticable.

That there is scarcely one in ten thousand, but what thinks otherwise, I am fully prepared to find. But, as owing to there being *fewer* than one in ten thousand, aware of the capabilities we possess, the impediment will, in the eyes of the many be, not *whether*, but *how* it can be done; and as owing to the scale on which Leslie's method of producing intense cold can be applied, it is indubitably in our power to cool the air in its condensed state, to whatever we please, and consequently to render the precipitation of its vapour certain: and also, as provided the *principle* is but applicable, the

advanced state of chemical science, and our manufacturing and mechanical means, will soon surmount the mere *difficulties of application*, insurmountable as they may appear, I am content to bear the charge of advocating, a medical Utopia.

These, are the advantages I consider we may ourselves, and at home, derive from it.

But great as these advantages are, yet can I not but hope that they may be placed lower in the scale of estimation than others yet to be enumerated.

Since, if the view I take of the subject is correct, and what I propose as to reduction of temperature practicable to the extent I consider it, it is not in the light of an addition to the conveniences and luxuries of man only, that the subject is to be viewed, but as a mean by which, it is *possible*, the ranges of those dreaded scourges, the plague, and yellow fever, may be circumscribed.

The circumstances which cause me to *hazard* this observation, are these. From the effects, which warm weather produces as to the spread, and cold weather as to

the prevention, of the plague* and yellow fever, it may be inferred, that to their propagation, an atmosphere of somewhat elevated temperature, is absolutely necessary; and that against their propagation, an atmosphere of *very* low temperature, is a positive preventative. Now, if so, it may be expected, that the method of cooling air which has been described, places in our hands, the power of circumscribing these depopulating scourges. Since, operate as I propose, and any building, even under the line, may be supplied with an atmosphere low as that of the frigid zones; and supposing this to be done with reference to a hospital, for plague, or yellow fever subjects, and that it were constantly kept at a temperature, *considerably below* the freezing point, might not the contagious influence be, if not destroyed, yet so neutralized, as would free those who attended the infect-

* "If all this be true, there is the less reason to presume that the plague was the product of the atmosphere in that year; since cold is generally admitted, to be, not only adverse to its production, but incompatible with its existence."—Sir A. B. Faulkener, M. D. in his late Treatise on the Plague.

ed from any risk, except that arising from actual contact; and if this should prove to be the case, would not the ranges of those awful visitations, be brought almost within our control?

This is the principal advantage, which *I am willing to hope may* be derived from what I propose; and although its magnitude, and the extent to which it would be a blessing, are too great to admit of its being lightly presumed on, yet, as it is amply within the verge of possibility—as it is not, abstractedly considered, more remote from expectation than other capabilities of which philosophy has possessed mankind—and as indulging the anticipation cannot be injurious, and may lead to investigations productive of general benefit,* I shall yield to the pleasing idea, of what are the advantages which might be derived from it, supposing it to have the effect I suggest.

* A friend of mine, who is a Spanish merchant, has informed me, that one of the clerks of his house of business at Cadiz, when given over, on an attack of yellow fever, and deemed so beyond remedy, as for the physician to have desired them to order his coffin, was recovered, and restored to health, by being rubbed over with, and, as it were, bathed in, pounded ice.

And taking them as they appear to stand in the scale of precedence, the application of the principle at Gibraltar and Malta, may perhaps be deemed the principal advantage we should ourselves derive from it, would it have the effect I have been suggesting? As then, the establishment of hospitals on the principle there, would possess the garrisons of means of counteracting those constantly dreaded scourges the plague and yellow fever, which could only be sufficiently appreciated, were some of those circumstances which occasionally frustrate the most judicious preventive regulations, to introduce the infections among them.

Sierra Leone, is that of our own possessions which would rank next to Gibraltar and Malta; owing, not to the plague, or yellow fever, but to the losses the colony annually experiences from the insalubrity of the rainy season; and though it is not supposed that climate could be so counteracted as *altogether* to prevent this, yet do I trust that it could mainly be counteracted.

Since, as in addition to supplying any hospital which should be erected on the

principle, with a cool medium of respiration, it is (as I have shewn with reference to a dry atmosphere for consumptive and asthmatic subjects) also possible to render the air which should be injected, dry as that of our climate in fine weather ; so that instead of having as they now have, the fever of the country heightened by the hot, humid, steam-like atmosphere of the rainy season, invalids might then constantly be in, and respire, an atmosphere always dry, and of a pleasant temperature; and as this is what it might be expected, would most materially tend to counteract the diseases the rainy season gives birth to, there is perhaps no other of our colonies where a provision of this nature would be more a blessing, than it would there.

To those also of our foreign possessions, whose importance renders it necessary they should be garrisoned, notwithstanding insalubrity of climate or situation; to such, the principle might be applied with most beneficial effect as to the health of the troops; as, by having a building large enough to allow them to take constant in-door exercise, in the dry, temperate, and salu-

brious atmosphere, any place might be supplied with, their health and spirits (supposing them to have to endure the confinement of a long rainy season) would be so kept up, by the recreative exercises which would be resorted to for amusement's sake, as would materially counteract the climate, and, it might be expected, much decrease the mortality of Europeans.

Such are the advantages we may nationally derive from it.

Those, which others may derive, vary with their situations: and the parellel of latitude may be considered as a general ratio of appreciation; the higher latitudes having less, and the lower, greater occasion for it than ourselves.

And looking at it thus, it might be expected to come into general use in all places within, or near the tropics,* where the expense of it could be afforded.

* The south, or rather the whole, of France,—Spain,—Portugal,—Italy,—the coasts and islands of the Mediterranean, Adriatic, &c.—our East Indian empire, and the south of Asia in general:—wherever in Africa they are sufficiently civilized;—the West Indies, and portions of both North and South America, &c. &c. &c.

Since, though this expense would be great, yet as effeminacy and desire of ease, are the characteristics of hot climates, and as nothing would there be so great a luxury, as the temperatures which the method I propose would enable them to command, it would not perhaps be too much to say that even poverty would tax itself, to procure the relief and gratification which could thus be given; particularly when it is considered, how abundantly it will both supply them with ices, and enable their beverages being cooled as they please.*

* "In this Island, the use of ice at table is considered as a mere luxury; but, in the hot climates, it is viewed in a very different light—as an indispensable necessary of life, and highly grateful and salubrious. The ancients were accustomed to cool their liquors during summer, by mixing with them pure snow, carried down on purpose from the mountains. But, about the middle of the fifteenth century, the method was discovered in Italy, of freezing water, by application of the superior cold, produced from the mixture of snow, with salt, or nitre. In the East Indies, great expense and attention are bestowed, in procuring the refreshment of cool drinks. On the coast of Malabar, the air is generally too humid for producing any considerable effect by evaporation; but, in the interior of the province of Bengal, during the continuance of the dry season, when a piercing wind gene-

But of all settlements and possessions in

rally blows from the lofty mountains of Thibet, films of ice, about the thickness of a shilling, or half-a-crown, are gathered in the mornings, from the surface of shallow earthen pans, set close to the ground, in pits, lined with the bamboo reed, and which have been filled the preceding evening, with water previously boiled, and again suffered to cool. These thin sheets of ice, are immediately rammed together into a compact mass, and sent down, packed in wool, to Calcutta. But, during at least four months of the year, this resource totally fails, and the settlers, deprived of their usual indulgence, then suffer from excessive languor.

"In the West Indies, again, and the adjacent shores of America, our colonists are, at all times, left without such relief, to assuage the burning heats of a pestilential climate. Even at home, ice-houses often fail in their construction, and are seldom found to answer, in the southern and western districts, such as Devonshire and Cornwall. To procure ice, therefore, independent altogether of the disposition of the sky, is a benefit of no small importance. A minute fragment of ice will yet be sufficient, in melting, to chill a very large body of water. But the cold affusion, has been employed with the happiest success, at certain stages of fever. Cooling draughts may, in many cases too, be administered with obvious advantage; and though medical writers are not always consistent, either with themselves or with nature, the uniform belief and experience of whole nations, sufficiently establish the utility of the application of cold, both *externally* and internally, in a wide variety of disorders which assail the human frame."

Leslie—Relations, &c.

the other continents, Batavia, that "grave of Europeans," is the place which (with the exception of America, should it operate with reference to the yellow fever as I have suggested) might perhaps derive most extensive benefit, from the adoption of the plan; owing to the superiority of its European population, to any settlement, on an equally insalubrious spot; and the consequent greater importance of that application of it, which should supply them with cool and dry atmospheres, notwithstanding the exhalations, the excessive heat raises from their stagnant canals.

And as to the only objection there can be, to the thus counteracting climate—the expense—where is he among us, who, knowing the mortality of the rainy season at Sierra Leone, would urge this, should the effect be what I suggest, and the expense no more than I anticipate; that is—first, two buildings; one to serve as a hospital, and the other (being long, wide, and high) as a place of exercise, and invigorating recreation (walking, bowls, tennis, &c. &c.) for the European population of

the settlement during the rainy season; secondly, a steam-engine with condensing and exhausting pumps, sufficient to operate to the necessary extent; thirdly, a sufficient series of receivers; and fourthly, the apparatus which would be necessary for precipitating the vapour of, and consequently drying, and then warming again, the air which is to be injected.

These things, with the attendance and fuel of the engine, and the acid for taking up the vapour the vacuum would cause, is all the expense it would occasion; and as this, when put in competition with the object in consideration, is (nationally speaking) as nothing, provided it does but effect what I suggest, it would not, were the effect certain, instead of only probable, deserve consideration; though, as the whole expense would most likely fall short of 20,000*l.* and as, if effective, the colony would be provided with a permanent means of counteracting the confinement, steam-like atmosphere, and insalubrity of the rainy season, it would be worth the trial even if thrown wholly away.

Such are the benefits, I am *willing* to expect, may be derived from what I propose; and as, be what I have *hazarded* as to the prevention of contagion futile as it may, neither the application of the principle to purposes of ventilation, to the relief of consumptive cases, nor to the counteracting insalubrity of climate are affected, in one or the other of these ways, it must, I conceive, be made to conduce to the benefit of mankind. Since, as the spring and principle of the proposition is power, and as power (let me have erred in my estimate, and underrated that which would be necessary, as I may) is what the mechanical agencies the world now possesses renders a matter of easy attainment, let it but be proved, to have either of the effects I have been pointing out, and its adoption would soon become as much matter of course, as any long followed provision, against insalubrity of situation.

But the advantages which public assemblages among ourselves might derive from this method of ventilation, are greater than have yet been noticed; as, by a variation of

apparatus, the means employed, in summer, to cool the air to whatever we might wish, may, in winter, be made use of to warm it; and to supply us, not simply with atmospheres of whatever temperature we might desire, but also, so to supply them, as shall both prevent any place ever becoming either hotter or colder than we might wish, and do utterly away with, and render totally impossible, the chilling and dangerous drafts, and currents of cold air, experienced by all, who are near the doors or windows of crowded places; so that any one might sit close to either door or window, without ever being annoyed by the least draft from them; and also, would people of delicate constitutions be relieved from danger of taking cold, owing to the transition from an excessively hot to a cold atmosphere, as is now the case when leaving places of public resort in cold weather.

That this may be done, will be seen, if the principles on which "drafts" take place are familiarly illustrated.

There are two principles which operate to alter the state of air, in any place where

numbers of people convene. One of them affects it physically, and to a change of density; and is the cause of drafts and influxes of cold air: the other affects it chemically, and to a change of quality, as the medium by which the action of the lungs is rendered efficient to the preservation of life; and renders necessary, and indeed indispensable, the drafts and currents of which the first is the cause. The first of these occurs, as to any place in which air is heated; the other, only in those places, in which it undergoes respiration. Now, it is the first only of these that falls under our consideration, when directed to the principle on which drafts take place; and the course of operation of this principle is thus. If heat be communicated to a particle of air, a change takes place as to that particle in the following manner; it becomes expanded and increased in bulk, in some such way as may be conceived by reference to the juvenile practice, of holding a flaccid bladder before the fire, to tighten and fill it up again, prior to using it as a football.

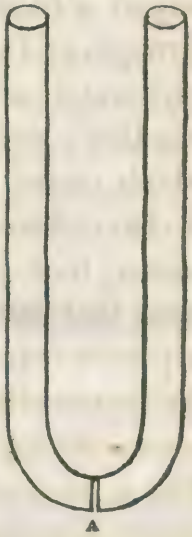
By this expansion it is increased in bulk,

but not in weight, and in consequence, rises from among the other particles, and ascends toward the ceiling; in the same way as a bladder filled with air would rise through, and swim at the top of others filled with water, were they thrown into the sea together: and, as the only circumstance which caused this particle to be where it chanced to be, at the time this supposed heating took place, was its gravity, the moment that becomes altered, and it, in consequence rendered specifically lighter than the surrounding particles, it ascends, and passes through them toward the ceiling. This is the course of operation of the principle; the effect of it is this. As soon as this particle of air has moved away from what heated it, its place is taken by another, which, undergoing the same change, passes off in like manner, having its place taken by a third particle; and this alternation continues, all the while heat is thus communicated, be the communicator what it may, whether the human body, a stove, or any other method of heating.

This is the effect of air's being heated; its

physical state is altered, and it becomes specifically, lighter than it was before.

The consequence of its becoming lighter, may be conceived thus. If you were to take a glass tube, shaped in this manner, with a notch or crevice cut in it at A, to which notch or crevice, a metallic slide were well and tightly fitted, so as to cut occasionally off the communication between the two legs; if, into a tube such as this, you were



(when the slide was pushed in, so as to cut off the communication) to pour, in one leg quicksilver, and in the other water, and then, when both were full (placing the thumb on the top of the leg that had the water in it, so as to keep it in) you were to pull out the slide between the quicksilver and water, so as to let them press one against the other, it is very evident, that the superior weight of the column of quicksilver, would cause it to press the column

of water upward against the thumb, and that, were the thumb removed, the water would be driven up, and some of it forced out of the tube; and also, that the water would continue to rise, till the contents of the two legs counterbalanced each other. Now, this is an illustration of what takes place as to any building, whenever the air inside it, is hotter than the air without.

Since, as the external air, is then heavier than the internal air, the former so operates upon the latter, as to press it upward against the ceiling, in the same manner as the water would be pressed against the thumb; and if a part of the ceiling be cut away, so as to open a means of emission similar to what the removal of the thumb permitted; that is, if a ventilation aperture be opened in the ceiling, the superior weight of the cold external air, will cause it to drive the lighter internal air, up through that aperture, till the equilibrium becomes restored; and if, owing to the air on the inside being, by the respiration, &c. of people convened in the building, kept constantly warmer and lighter than the external

air, this equilibrium is prevented, and the difference between the external and internal atmosphere, kept permanently up, the consequence then will be, that instead of a single and transitory emission, like that of the water from the tube, there will be a continuous emission of air through the ventilator, all the while the respiration &c. of those who are assembled in the building, keeps up the difference. Now this is what takes place in all public places; and, as owing to the doors and windows being during cold weather, kept shut, the aperture of admission (or channel, by which the external air enters the building) is rendered very much smaller than that of emission; to make up for the difference thus caused between the apertures of admission, and emission, the cold external air, is as it were, obliged to make use of all the cracks and crevices that are about, either the doors and windows, or elsewhere around the building; and to introduce itself through them, with a velocity so much greater than that at which it passes off by the ventilator, as will make up for the difference be-

tween the sizes of the cracks and crevices by which it enters, and that of the ventilation aperture.

This is the reason, why drafts are experienced from the crevices of doors and windows: the heated and respired air passes off by the ventilator; to make up for what so passes off, fresh air flows into the bottom of the building; and as, when the weather is cold enough to make us shut the doors and windows, ingress, by a duct equal to that of egress is prevented, to make up by the rate at which it enters, for the difference in the sizes of the apertures of admission, and emission, the air that finds its way in through cracks and crevices, enters with so great a velocity, as to cause the chilling currents we experience.

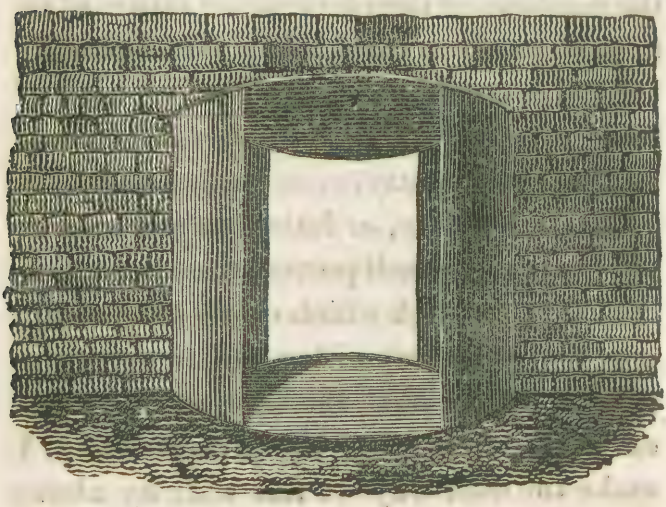
It will be as well to remark here, that if this is the cause of drafts and currents through cracks and crevices, it may be observed by some one, that all that it would be necessary to do to prevent them, would be to have somewhere in the building an aperture of sufficient size to let air in, as fast as it passed off by the ventilator; as

then, the necessity for its entering by cracks and crevices being prevented, it would either not come in at all through them, or with so diminished a velocity, as would prevent its annoying as it now does, those who are near them. This observation may very justly be made. But although the effect would certainly be according to it, yet would there be attending it the disadvantage, of the remedy's being worse than the disease. Since, as the air that entered through this aperture would be cold external air, its admission would be attended with so chilling an effect, as would render it necessary instantly to close the aperture, and to submit to the old inconvenience of drafts. But, as the first principle of the method by which I prevent drafts, is by injecting, not cold air, but air raised to whatever temperature the coldness of the weather may render desirable, the inconvenience I have been shewing is completely obviated; as will be seen by giving the course I follow.

Instead of suffering ventilation to take place at, as it were, the pleasure of the air,

I restrict and regulate it thus. I first have the windows of the place nailed down, so as to prevent them from being ever opened: I then have the joints and crevices, both of these windows and of the room in general, so filled with putty, or so treated with any such kind of lute, or luting, as will answer the purpose, as shall prevent their becoming channels, through which drafts or currents may find their way either *into*, or *out of* the place. I then have the door-ways arranged thus. Removing the present doors, I make the door-way six feet wide by about the same height, and have fitted, and (by puttying, luting, &c. &c.) made air-tight into it, a cylinder (of wood or metal) closed at both ends, and placed upright on one of them, so as to appear somewhat like a cask built into the wall. Through the side of this cylinder I have two apertures cut, each about four feet wide by the height of the cylinder inside its ends; which apertures are opposite; the middle of each, being in the line of the centre of the cylinder, so as to leave a way of about four feet wide, right through the middle of it into the

place, as shewn beneath, where the cylinder



is represented as placed in the wall, with the apertures in it. In the centre of the cylinder, I have now put (perpendicularly) a shaft, of about three inches diameter, and of the length of the cylinder; and having it, and the centres of the top and bottom of the cylinder, so prepared and fitted to each other, as that the shaft may easily turn round or revolve, I then have fixed on it, at right angles to each other, and four at top, and four at bottom, eight arms, or radii; the bottom four, being exactly under the upper ones. To these arms, I have

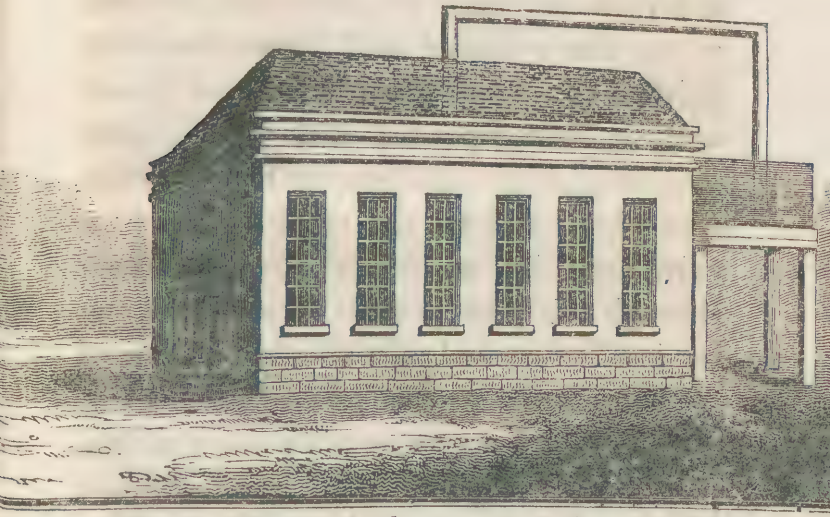
fixed four sheets, or pieces of iron plate, of such lengths and widths, as will just go into, and fill up (though without touching) the space, left between the shaft, and the side of the cylinder; and these things being so done, as that the plates or leaves fixed on the arms, may turn easily round inside the cylinder; and the inside the cylinder, and the ends and sides of these leaves, being so fitted to each other, as that, when the leaves are turned round, there may not be a space, greater than about the sixteenth of an inch, left between them, the arrangements for the door-way are complete; and the cylinder, through which the place is entered, has within it, four leaves, or wings, somewhat like the fans of a winnowing machine, fixed perpendicularly.

Now the effect of these arrangements, is this. Were a common door to be made use of, whenever it was opened, free egress, or ingress, would be given to air, and it would pass from, or into the place, as circumstances dictated. But with a door, arranged as I have described, no air can, at any time, pass either into, or out of the place,

excepting, by the narrow space, or crevice, left between the edges of the leaves, and the inside the cylinder; since, as the leaves are all at right angles with each other, and as the two apertures in the cylinder are neither of them so wide, as to be equal to ninety degrees of a circle of the same diameter as this door-way cylinder, it follows, that turn, or cause the leaves to revolve as we may, two of them will always be within the uncut parts of the cylinder, and constantly interposed, between the inside the place, and the open air; and, in consequence, there never can be any other passage for air, into, or out of the place, by this door-way, than by the space or crevice, between the edges of the leaves, and the inside the cylinder.

When the windows and door are thus finished, I proceed as follows with the ventilator. To the aperture in the ceiling, through which ventilation takes place, I have fixed a pipe of the same diameter as that aperture; which pipe, goes through the roof, and then descends, and opens into a reservoir, or cistern, as represented

beneath, where the dotted line shews the pipe inside, and the continued line shews it outside the roof.



Now, with things thus arranged, and with the cistern so far filled with water, as immerses the end of the ventilation pipe a few inches in the water, I set the machinery, by which the warmed air is injected at work; when air, fresh, and of a temperature pleasant to the feelings, is injected at such a rate, as is sufficient for the consumption of the people inside; and as from the arrange-

ments, and lutings I have mentioned, the only places were this air can find egress, are, through the ventilation pipe, and by the spaces or crevices, between the doorway cylinder, and the leaves that revolve in it; and as these spaces or crevices, are, when the cylinder and leaves are well finished and fitted to each other, as almost nothing, in comparison with the quantity of air injected, it follows, that the ventilation pipe must be the main channel of exit; and also, as before any air can pass through this pipe, it must displace the water inside that end of it which is immersed in the cistern; as, to displace this, a slight pressure must be thrown upon it; as the causing this pressure, will somewhat (most trivially to be sure) condense the air in the ventilation pipe; and also, as this condensation, will, owing to that principle of fluids, by which action and reaction are communicated, be reverted, or reflected back upon, and caused to take place with respect to, all the air in the place, the whole of it will be somewhat condensed, and, in consequence, the place will have in it a quantity

of air, greater than what it would under common circumstances have, according to the depth, to which the end of the ventilation pipe, is immersed in the water; and as this compressed state of the air, and the place's thus having within it, more than it would under common circumstances contain, and being, as would vulgarly be said "more than full," is contrary to the natural tendencies of air, its expansive principle will be exerted, and every crack, and crevice about the place, will become a channel, to let air *out* instead of *into* it; and, in consequence, drafts *into* the place effectually prevented, owing to every cranny, through which they used to enter, becoming a channel of *egress* instead of *ingress*.

This is the way in which I prevent and do away with "drafts:" and when the door, and ventilation apparatus (which is in fact, nothing more than a most sensitive valve, and to which, a valve, would, under some circumstances, be preferable) are well arranged, and their effect not counteracted, by any of the cracks and crevices which are about rooms, being suffered to remain unluted, or otherwise unstopped, it will be

found most efficient, and the evil it is intended to remedy, effectually done away with.

There is, to be sure, both singularity, and a degree of inconvenience, in a door-way such as I have described; though, as by having the pannels, of the revolving leaves, of glass, this might be much done away with; and as there is no other equally convenient way, of preventing all possibility of annoyance from the door, whenever any one either entered, or went out of the place, it might be submitted to, should common doors not be considered sufficient.

With the prevention of inconvenience, and the danger of taking cold *inside* the place, would also be the removal of much of the liability to cold, &c. when leaving, the now highly heated atmospheres of public places. As, owing to the temperature's being always uniform, and never above that which was agreeable and salubrious, much of the danger we *all* experience, and many of the indispositions people of delicate constitutions incur, in consequence of passing from the now (again to admit a vulgar idiom) almost "melting" atmospheres of

public places, to the open air, would be done away with.

The measures I take to warm the air which would be injected, it will be but waste of time to describe; it being sufficiently evident, that there are plenty of ways of doing this. Merely observing, therefore, that availing myself of an apparatus I several years ago invented—of the high temperatures, which the fixed oils bear without vaporization—and (it may be) taking advantage, of an opportunity which the process would offer, of facilitating the heating the air, by somewhat increasing its capacity for caloric by slight rarefaction, I warm the air to whatever may be agreeable prior to injecting it, I dismiss this portion of the subject.

And having thus shewn the whole course of ventilation entirely in our hands, I might conclude, were it not, that the measure of exclusive appropriation to which I have been driven on the subject, renders it necessary, to enter on some detail, as to the cause of that measure.

It is now nearly four years, since I have seen it impossible by the present method

of ventilation—that is, by permitting the air to enter and pass off, at, as it were, its own pleasure, either to preserve uniformity of temperature in any place of public convention, or to prevent drafts; and since I have endeavoured to gain public attention as to the only method by which these desiderata can be attained—that is, artificial ventilation—or ventilation, by the air's being first, cooled, or warmed, as the season dictated, and then mechanically injected, instead of being suffered to enter, and leave the building, as the temperature, and consequent levity, of the respired and heated air, and the size of the ventilation aperture regulated.

As, however, my first view of the subject, confined itself to the application of the principle to the ventilation of the Houses of Parliament, I did not attempt any thing more, than the getting it brought upon their notice, under the patronage of a member of the Upper House, who considered what I proposed, as important, if practicable. But, as, to carry the thing through, required more fostering than he, and more solicitation, &c. (to those to whom it was

necessary to apply) than I chose to give it, nothing resulted, other than a debt of gratitude to the noble individual by whom I had been countenanced; and in the state in which it was thus left, it remained until about twelve months since, when, circumstances apparently favourable to its being moved in occurring, I again endeavoured to get it taken up. But, as occurrences during this interval, had both given me additional confidence as to its practicability, and caused me to perceive, that the places in which its application would be the greatest relief, were the courts of Law, I determined to bring it more publicly forward, and to attempt interesting those whom it would most benefit, in its behalf.

But being in this also unsuccessful,* and having then (as a nameless, and unknown individual) no other course left, soon after

* As some of the repulses I met with, were founded upon the room it would require, and others, upon the (as it was termed) impossibility of manufacturing apparatus, on a scale of sufficient magnitude, &c. &c. it may be as well to observe, that, as to the first, it will take up *no room whatever* in the place to be ventilated, the principle (like that of

the commencement of last session, I tried the sole remaining resource, of petitioning Parliament on the subject, (See App.) and failing also in this, as I had then done all I could to benefit the public without reference to myself, and as the repulses I had met with, had somewhat cooled my ardour for, and opened my eyes to the folly of coming forward, as anxious for the public benefit only, I determined to make my own advantage the primary consideration; and accordingly, sued out a patent for it. Owing to a series of repulses therefore, the whole of which, at the periods of their occurrence, ran directly counter to, and were

gas works) admitting of the operation's being performed either upon, adjoining to, or at a distance from the premises, according to convenience: and, as to the second, though there will be some difficulties of preparation to encounter, yet, that they are no more, than the casting receiving cylinders, of a rather unusual size and substance—the preparing, somewhat novel machinery and tools, for boring, turning, and fitting up, the condensing cylinders, and pistons—and the a, b, c, work, of putting Professor Leslie's principle in execution, on a scale of the greatest magnitude, instead of on a table scale—in other words, building a ship of the line, instead of a fishing boat.

the very reverse of, my wishes and efforts, I am become possessed of the sole right of operating in a way, which, if I see correctly, will be, not alone important to ourselves at home, but also important, and that too in the highest degree, to some of our foreign possessions. Of this am I, in consequence of many disappointments, and a long series of repulses and denials, become possessed. In what degree the good, which fortune has thus, in spite of myself bestowed upon me is to be estimated, it would be difficult to decide. Though, as, should what I propose, have the effects I suggest, it would become matter of public interest; and, as a private individual's exercising control, over matters of public interest, is altogether foreign to the spirit of our constitution, should the suggestions I have risked, be so borne out, as to render the subject at all nationally important, I shall be prepared, becomingly to defer to the opinions, of the guardians of the public welfare, with reference to it.

THE END.

APPENDIX.

APPENDIX.

To the Honourable, the Commons, of the United Kingdom of Great Britain and Ireland, in Parliament assembled.

The humble Petition of John Vallance, of Brighton, in the county of Sussex,

Sheweth,

That your petitioner, hath discovered a method, and invented corresponding apparatus, by which public buildings, such as your Honourable House, the Right Honourable the House of Lords, and the courts of public justice of the kingdom, may be freed from the distressing heats, and unhealthy atmospheres, sometimes experienced in them, and kept constantly cool, and of a pleasant, and agreeable temperature, at all times of the year, even during the dog days; and that, as the heated and deteriorated atmospheres of the courts of justice, undermine, and operate as slow poisons, as well upon the constitutions of the Dignitaries of the Bench, as of those, learned in the law, who conduct the proceedings of those courts; and this, independent of the inconvenience, occasioned to such of the magistracy, and gentry of counties, as attend the courts of assize: as these circumstances, render your Petitioner's discovery, in his own humble opinion, a national object, he prays, the being allowed to prove, before a Committee of your Honourable House, the perfect practibility of it, that your Honourable House, may thereon direct such measures, as to your wisdom may seem meet,

And your Petitioner, &c.

*** The Petition to the Lords was not presented, owing to the Peers to whom I applied, *recommending* that it should not.

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